

ENGINEERING MATERIALS OFFICE  
SOIL MECHANICS SECTION

WP 33-76-11

DIST 6

HWY NWMA

STR SITE 37-1077

Ramp NS-E Over  
Black Creek Channel

DISTRIBUTION

G.C.E. Burkhardt (3)

P.D. Gunter

M.R. Ernesaks

D.E. Thrasher (2)

C. Grebski

G.A. Wrong

B.J. Giroux

R.S. Pillar

R. Hore

R. Fitzgibbon )

J. Anderson ) cover only

G. Sloan )

Files ✓

SAMPLE DISPOSITION NOTICE		
TYPE	DISCARD AFTER	RECOMM. BY
JARS	78 08 15	M.A.
TUBES	-	-
ROCK CORES	-	-

# FOUNDATION INVESTIGATION REPORT

For

Ramp NS-E Over Black Creek Channel  
W.P. 33-76-11, Site 37-1077  
N.W.M.A., District 6, Toronto

---

## INTRODUCTION

This report contains the results of a foundation investigation carried out at the above mentioned location. The fieldwork was done between April 24 and May 2, 1978 utilizing an auger machine equipped with hollow stem continuous flight augers. This fieldwork consisted of 4 sampled boreholes accompanied by dynamic cone penetration tests plus one individual cone test. The boreholes were advanced to depths ranging from 76.5 feet to 128.5 feet below ground surface.

## DESCRIPTION OF THE SITE AND GEOLOGY

The site is located approximately 400 feet southeast of the existing Hwy. 400 dead end at the Jane Street Interchange, Toronto.

Earthfill has been placed at this site on either side of the re-located Black Creek Channel along the proposed Northwest Metro Arterial (NWMA) alignment. Generally, the natural topography in the area is flat to gently sloping. The predominant land use is residential and light commercial.

Physiographically, the site lies in the South Slope Region which is the south slope of an interlobate moraine composed of clayey silt till deposited during the Pleistocene Ice Epoch.

## SUBSURFACE CONDITIONS

The site is covered by an extensive deposit of glacial till extending to depths ranging from 99.0 feet to 101.0 feet. Underlying this stratum is a deposit of sandy silt to silty sand which was proven to a maximum depth of 27.5 feet below the till. A fill embankment consisting of parent till material to a maximum height of 30 feet covers most of the site.

The boundaries between the various soil types are shown on the attached Record of Borehole Sheets. The locations and elevations of the borings, along with an estimated stratigraphical profile based on the borehole data, are shown on Drawing No.337611-A.

The various subsoil types encountered are briefly described as follows:

#### Fill

The earthfill that covers most of the site is composed mainly of a clayey silt some sand and traces of gravel. The thickness varied from 6.5 feet at the west channel berm to 16.5 feet at the crest of the west channel slope. The physical properties of the fill material are similar to those of the underlying parent till material. The 'N' values from the Standard Penetration Test for this material ranged from 7 blows/foot to 20 blows/foot, indicating that the fill is moderately to relatively well compacted. On the east berm of the channel the fill material consisted of a silty sand with organics of shallow depth. The 'N' values indicate a denseness of compact at this location.

#### Clayey Silt With Some Sand and Trace of Gravel (Glacial Till)

Underlying the fill material is a glacial till stratum of clayey silt with some sand and a trace of gravel containing occasional seams of silt and fine sand. This stratum was found to vary from 99 feet to 101 feet over the site. In localized areas, organics were found to be well dispersed in the upper portion of the deposit beneath the fill. Occasional distinct layers of silt with sand were also encountered in this deposit.

Laboratory testing consisting of Atterberg Limits, moisture content, grain size analysis and undrained shear strength measurements on material of this deposit gave the following results:

		<u>Range</u>
Natural Moisture Content (W)	%	11-30.5
Plastic Limit	(W <sub>p</sub> ) %	11-21
Liquid Limit	(W <sub>L</sub> ) %	18-38

Undrained Shear Strength (psf)	
as determined by: Field Vane	880- >2000
Lab. Unconfined Compression Test	975- 3955
Sensitivity	1.0-3.0

Generally, these results indicate that the clayey silt is inorganic of low to moderate plasticity. However, a clayey silt to silty clay with little or no sand and gravel of higher plasticity was encountered at depths ranging from elevation 340 to elevation 355.

The 'N' values range from 8 blows/foot to 80 blows/foot with an approximate average blow count of 20 throughout the deposit. Based on these results and in situ vane test readings, the consistency of the clayey silt is assessed as stiff to hard. A grain size distribution plot for this deposit is presented in envelope form on Figure 1 and plasticity chart on Figure 3.

#### Sandy Silt to Silty Sand

Underlying the clayey silt deposit and penetrated to a maximum depth of 27.5 feet, is a stratum of sandy silt to silty sand with traces of clay and gravel. The sand content was found to increase with the depth of this stratum. The 'N' values range from 56 blows/foot to 250 blows/foot which would indicate a very dense relative density for the stratum. A plot of grain size distribution for this deposit is shown on Figure 2.

#### Groundwater

Overnight groundwater levels were taken in open boreholes. However, these did not stabilize over the short period of the investigation. Generally, the water level can be expected to correspond to the water level in Black Creek.

## DISCUSSION AND RECOMMENDATIONS

A 3 span steel girder structure is proposed to carry the Black Creek on Ramp NS-E of the NWMA over the relocated Black Creek. The structure length will be 191 feet and will sit on perched-type abutments within the geometry of the existing fill.

The profile grade of the NWMA at the channel crossing is about elevation 417 necessitating a cut on the east side of the creek channel.

Considering the uniform subsoil conditions at this location, recommendations pertaining to the east and west abutments and piers of the proposed structure are as follows.

### Structure Foundations

The structure should be founded on friction piles in the clayey silt or end-bearing piles in the very dense non-cohesive stratum due to the presence of non-uniformly compacted earthfill on either side of the channel. It is further recommended that the structure be supported on #14 timber friction piles which would be considerably more suitable than end-bearing piles driven into competent strata at great depths. A safe bearing capacity of 35 tons can be developed on vertical timber piles driven to the following tip elevations:

<u>Location</u>	<u>Elevation</u>
West Abutment	358.25
East Abutment	355.00
West Pier	341.75
East Pier	339.75

In order to prevent the 54"  $\emptyset$  sanitary sewer, located parallel to the east pier footing, from being damaged during pile driving operations, piles within a distance of 6 feet from the sewer should be pre-augered with a 10"  $\emptyset$  auger to a depth of 5 feet below the sewer invert level. These augered piles can be designed for a safe bearing capacity of 25 tons.

Settlement of the pile foundations under the recommended loads are anticipated not to exceed  $\frac{1}{2}$  inch. These bearing capacity and settlement recommendations are based upon the results of a pile load test carried out in the vicinity where similar subsoil conditions were encountered.

In order to prevent the softening or loosening of foundation material in the bottom of the excavation by surface water or construction activity, a working pad of granular material or lean concrete should be placed to seal the base as soon as possible.

The underside of the pile cap should have a minimum earth cover of 4 feet to insure adequate protection from frost penetration.

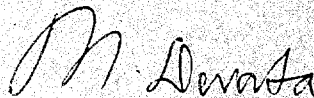
No major dewatering difficulties are anticipated for excavations of the pile caps due to the relatively low permeability of the clayey silt till. Local seepage into the excavation can be removed by pumping from sumps. High water levels in Black Creek during the pile cap excavation for the piers will require more elaborate dewatering procedures.

#### Approaches

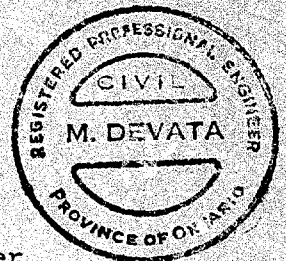
No stability problems are anticipated in the cut on the east side of the channel if the slopes are constructed not steeper than 2:1.



T. Kazmierowski,  
Project Engineer



M. Devata, P. Eng.  
Supervising Engineer



June, 1978

# RECORD OF BOREHOLE No 2

W P 33-76-11 LOCATION Coords. N 15,882,469; E 999,058 ORIGINATED BY T.K.  
 DIST 6 HWY NWMA BOREHOLE TYPE Hollow Stem Auger & Cone Test COMPILED BY T.K.  
 DATUM Geodetic DATE April 25 & 26, 1978 CHECKED BY

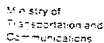
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			SHEAR STRENGTH PSF								WATER CONTENT (%)
								○ UNCONFINED	+ FIELD VANE	● QUICK TRIAXIAL						
						400	800	1200	1600	2000	10	20	30	PCF	GR SA SI CL	
404.7	Ground Surface															
0.0	Fill Material		1	SS	19										1 28 41 30	
397.7	Clayey Silt		2	SS	7										17 34 33 16	
7.0			3	SS	10											
			4	SS	8											
	With Organics		5	SS	19											
			6	SS	9											
	Clayey Silt		7	SS	14										11 23 43 23	
	Some Sand		8	SS	18											
	Trace of Gravel		9	SS	13											
	Grey		10	SS	11											
	(Glacial Till)		11	SS	17											
			12	SS	10											
	Clayey Silt to Silty Clay		13	TW	PM									123	0 3 37 60	
			14	SS	18											
	Occasional Sand Seams		15	SS	35											
			16	SS	32											
	Firm to Very Stiff		17	SS	36											
			18	SS	30										2 23 50 25	
			19	SS	63											
			20	SS	55											
	Occasional Silt Seams		21	SS	45											
303.7			22	SS	69										1 19 61 19	
101.0	Sandy Silt															
	Trace of Clay and Gravel															
	Very Dense		23	SS	175										9 26 55 10	
285.7																
119.0																

Continued

+3, x5: Numbers refer to  
Sensitivity

20  
15-5 (%) STRAIN AT FAILURE  
10

Continued



W P 33-76-11 LOCATION Coords. N 15,882,469; E 339,058 ORIGINATED BY T.K.  
DIST 6 HWY NOMA BOREHOLE TYPE Hollow Stem Auger & Cone Test COMPILED BY T.K.  
DATUM Geodetic DATE April 25 & 26, 1978 CHECKED BY [Signature]

[illegible]

+3, x5 : Numbers refer to Sensitivity

15  $\phi$  5 (%) STRAIN AT FAILURE



# RECORD OF BOREHOLE No 3

W P 33-76-11 LOCATION Coords. N 15,882,526; E 998,919 ORIGINATED BY T.K.  
DIST 6 HWY N.W.M.A. BOREHOLE TYPE Hollow Stem Auger & Cone Test COMPILED BY T.K.  
DATUM Geodetic DATE May 1 & 2, 1978 CHECKED BY [Signature]

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT  $\gamma$ PCF	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			SHEAR STRENGTH PSF				WATER CONTENT (%)				
								O UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE				10 20 30				
403.8	Ground Surface							20 40 60 80 100								
0.0	Fill Material		1	SS	11											
397.3	Clayey Silt		2	SS	12										0 1 69 30	
6.5	Clayey Silt		3	SS	14											
	Some Sand		4	SS	13										10 23 43 24	
	Trace of Gravel		5	SS	14											
	Grey		6	SS	14											
	(Glacial Till)		7	TW	PH								139		2 21 60 17	
	Firm to Stiff		8	SS	12											
			9	SS	13											
			10	SS	17										4 27 53 16	
			11	SS	20											
			12	SS	16											
			13	SS	21											
			14	TW	PH									140	5 26 47 22	
			15	SS	19											
	Grey		16	SS	PH										0 2 62 36	
	Clayey Silt to Silty		17	SS	20											
	Clay, Trace of Sand		18	TW	PM									123	0 2 43 55	
	Firm to Stiff		19	SS	70											
	Occasional Silt With		20	SS	68										0 3 68 29	
	Sand Layers		21	SS	80											
	Stiff to Hard		22	SS	33										1 17 65 17	
304.8			23	SS	56											
99.0	Sandy Silt		24	SS	207										0 35 57 8	
	Trace of Clay															
	Dense to Very Dense															
287.3																
116.5	End of Borehole															

+3, x<sup>5</sup>: Numbers refer to  
Sensitivity

20  
15  
10

5 (%) STRAIN AT FAILURE



# RECORD OF BOREHOLE No 4

W P 33-76-11 LOCATION Cords. N 15,882,499; E 998,888 ORIGINATED BY T.K.  
DIST 6 HWY NAMA BOREHOLE TYPE Hollow Stem Auger & Cone Test COMPILED BY T.K.  
DATUM Geodetic DATE April 28, 1978 CHECKED BY [Signature]

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN-SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			SHEAR STRENGTH PSF						
415.6	Ground Surface							20 40 60 80 100						
								○ UNCONFINED + FIELD VANE						
								● QUICK TRIAXIAL x LAB VANE						
								400 800 1200 1600 2000						
										10 20 30				
0.0	Fill Material Clayey Silt Some Sand		1	SS	13		410							0 15 69 16
			2	SS	8									1 13 65 21
			3	SS	7									
			4	SS	20									
			5	SS	17									
399.1			6	SS	10		400							
16.5			7	SS	8									
	Clayey Silt Some Sand Trace of Gravel Grey		8	SS	15									
	(Glacial Till)		9	SS	16		390	122						3 25 47 25
	Firm to Stiff		10	SS	16									
			11	SS	16		380							
			12	SS	16									
			13	SS	17		370							
			14	SS	18									
			15	SS	19		360							1 27 49 23
			16	SS	26		350							
338.1	Clayey Silt to Silty Clay		17	SS	15		340	2.0						
77.5	End of Borehole													

+3, x5: Numbers refer to  
Sensitivity

20  
15 5 (%) STRAIN AT FAILURE  
10



RECORD OF BOREHOLE No 5

W P 33-76-11 LOCATION Coords. N 15,882,495; E 999,019 ORIGINATED BY T.K.  
DIST 6 HWY 100A BOREHOLE TYPE Hollow Stem Auger COMPILED BY T.K.  
DATUM Geodetic DATE April 24 & 25, 1978 CHECKED BY [Signature]

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT Y pcf	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	N° VALUES			20	40	60	80	100					
401.7	Ground Surface						400										
0.0	Fill Material Silty Sand With Organics		1	SS	13												
25.7			2	SS	12												
6.0	Silty Sand Grey Compact		3	SS	9												0 57 32 11
388.7			4	SS	13												
13.0	Clayey Silt Some Sand Trace of Gravel Grey (Glacial Till)		5	SS	19												1 25 51 23
			6	SS	14												
			7	TW	PH												2 21 60 17
			8	SS	12												
			9	SS	16												
			10	SS	15												
			11	SS	15												1 22 47 30
	Clayey Silt to Silty Clay		12	SS	10												
			13	SS	9												
			14	SS	20												
	Firm to Very Stiff		15	SS	24												
			16	SS	26												2 23 52 23
			17	SS	33												
			18	SS	62												4 38 43 15
325.2	Silt With Sand Very Dense		19	SS	90												
76.5	End of Borehole  Note: Water Level Not Established																

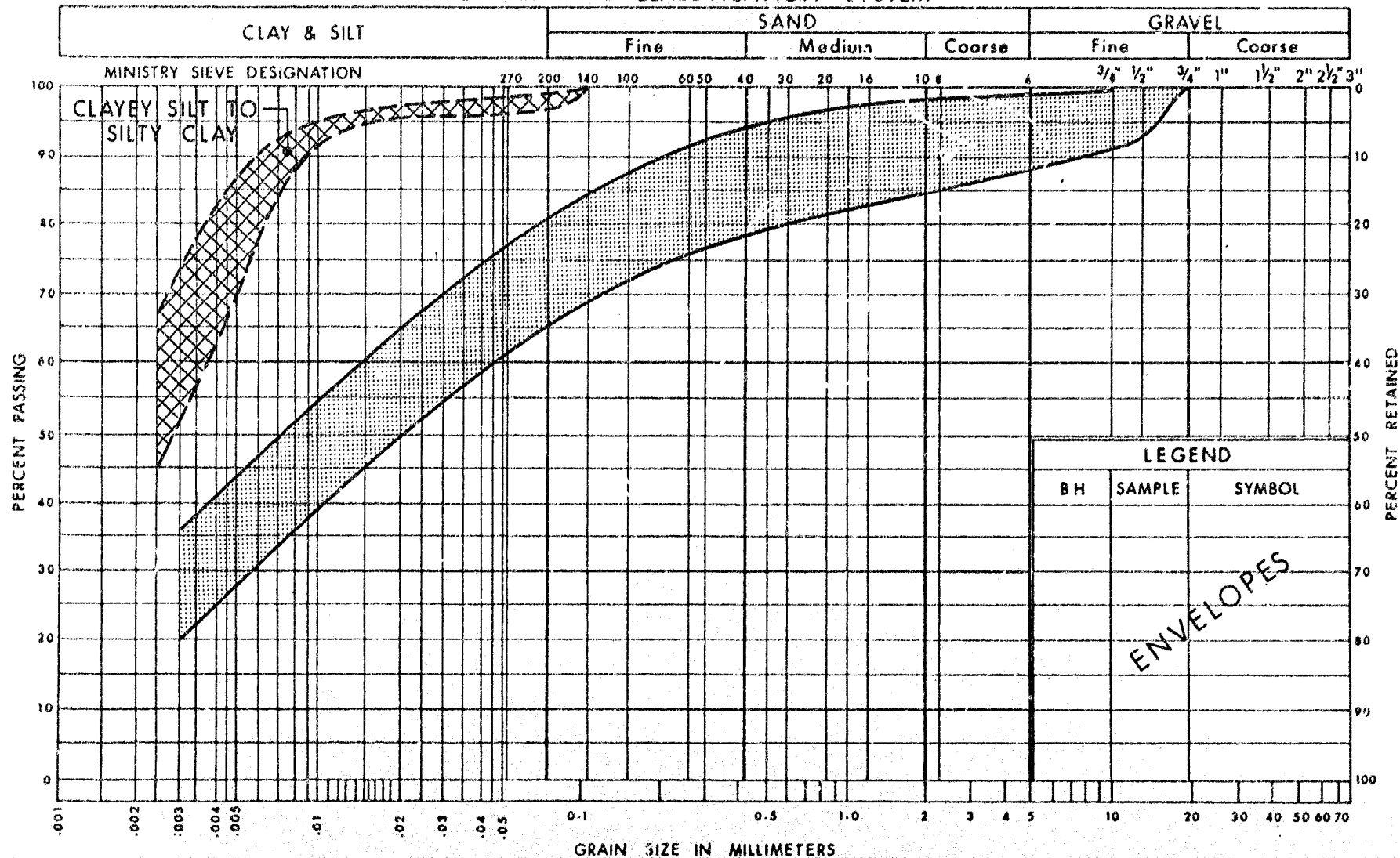


# RECORD OF BOREHOLE No 8

W P 33-76-11 LOCATION Coords. N 15,882,424 E 999,068 ORIGINATED BY T.K.  
DIST 6 HWY NVMA BOREHOLE TYPE Cone Test COMPILED BY T.K.  
DATUM Geodetic DATE April 26, 1978 CHECKED BY [Signature]

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 SHEAR STRENGTH ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE	PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT Y	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT. PLT	NUMBER	TYPE	VALUES								
403.0	Ground Surface												
0.0													
388.5													
14.5	End of Cone Test												

## UNIFIED SOIL CLASSIFICATION SYSTEM



GRAIN SIZE DISTRIBUTION  
CLAYEY SILT, SOME SAND, TRACE OF GRAVEL  
(Glacial Till)

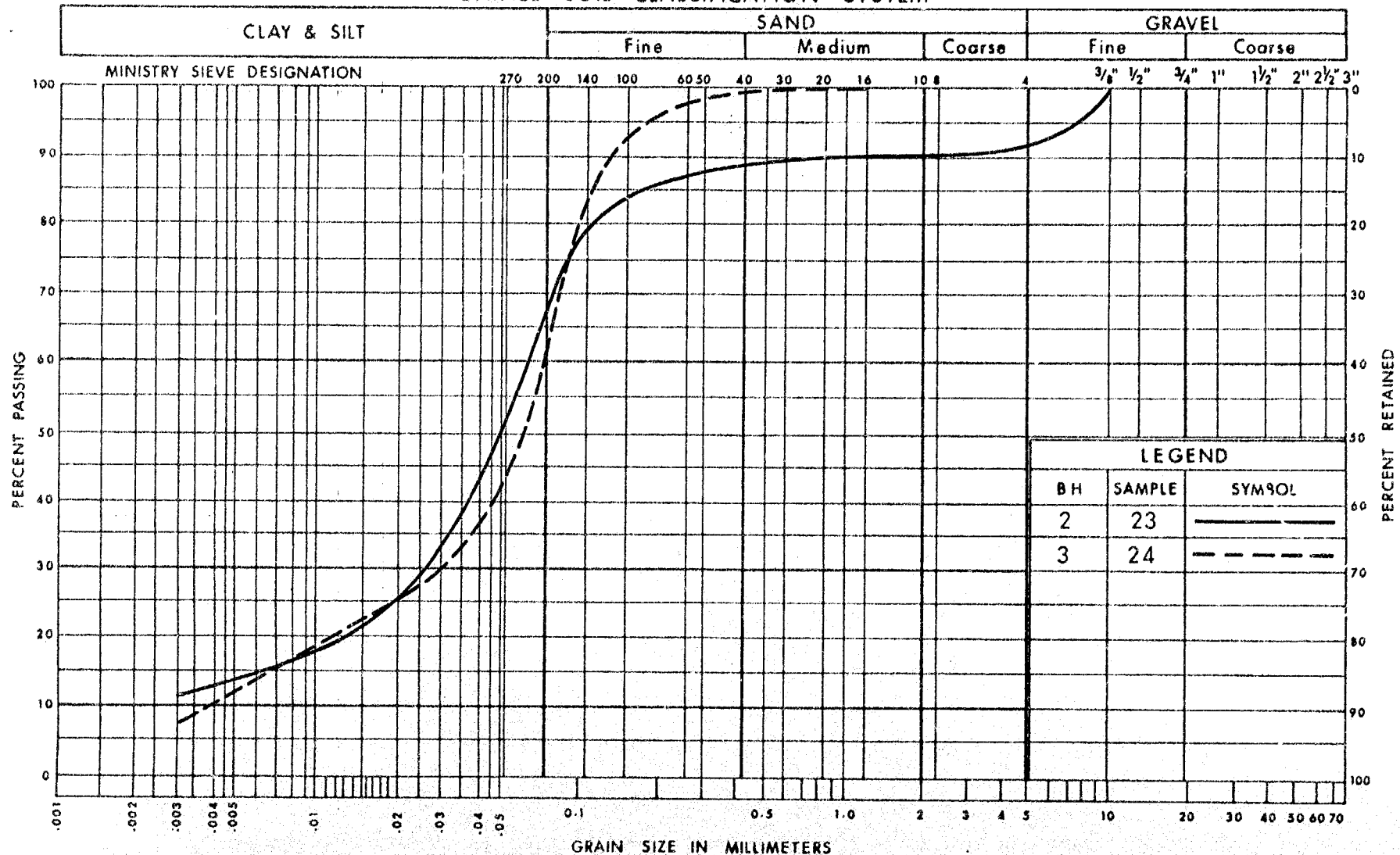
FIG No 1

W P 33-76-11



Ministry of  
Transportation and  
Communications

## UNIFIED SOIL CLASSIFICATION SYSTEM

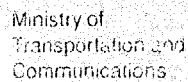


Ministry of  
Transportation and  
Communications

**GRAIN SIZE DISTRIBUTION**  
SANDY SILT, TRACE OF CLAY & GRAVEL

FIG No 2

WP 33-76-11



PLASTICITY CHART  
CLAYEY SILT, SOME SAND, TRACE OF GRAVEL  
(Glacial Till)

W P 33-76-11

# EXPLANATION OF TERMS USED IN REPORT

'N' VALUE: AN INDICATOR OF SUBSOIL QUALITY. IT IS OBTAINED FROM THE STANDARD PENETRATION TEST (CSA STD. A119.1). SPT 'N' VALUE IS THE NUMBER OF BLOWS REQUIRED TO CAUSE A STANDARD 2 INCH O.D. SPLIT-BARREL SAMPLER TO PENETRATE 12 INCHES INTO UNDISTURBED GROUND IN A BOREHOLE WHEN DRIVEN BY A HAMMER WEIGHING 140 POUNDS, FALLING FREELY A DISTANCE OF 30 INCHES. FOR PENETRATIONS OF LESS THAN 12 INCHES 'N' VALUES ARE INDICATED AS THE NUMBER OF BLOWS FOR THE PENETRATION ACHIEVED. 'N' VALUES CORRECTED FOR OVERBURDEN PRESSURE ARE DENOTED THUS  $N_c$ .

DYNAMIC CONE PENETRATION TEST (CSA STD. A119.3): CONTINUOUS PENETRATION OF A CONICAL STEEL POINT (2" O.D. 60 CONE ANGLE) DRIVEN BY 350 FT-LB IMPACTS ON "A" SIZE DRILL RODS. THE RESISTANCE TO CONE PENETRATION IS MEASURED AS THE NUMBER OF BLOWS FOR EACH 12 INCH ADVANCE OF THE CONICAL POINT INTO THE UNDISTURBED GROUND.

SOIL QUALITY: SOILS ARE DESCRIBED BY THEIR COMPOSITION AND CONSISTENCY OR DENSITY.

CONSISTENCY: COHESIVE SOILS ARE DESCRIBED ON THE BASIS OF THEIR UNDRAINED SHEAR STRENGTH AS FOLLOWS:

$S_u$ (PSF)	0 - 250	250 - 500	500 - 1000	1000 - 2000	2000 - 4000	> 4000
	VERY SOFT	SOFT	FIRM	STIFF	VERY STIFF	HARD

DENSENESS: COHESIONLESS SOILS ARE DESCRIBED ON THE BASIS OF SPT 'N' VALUES AS FOLLOWS:

'N' (BLOW/FT)	0 - 5	5 - 10	10 - 30	30 - 50	> 50
	VERY LOOSE	LOOSE	COMPACT	DENSE	VERY DENSE

ROCK QUALITY: ROCKS ARE DESCRIBED BY THEIR COMPOSITION AND STRUCTURAL FEATURES AND/OR STRENGTH.

RECOVERY: SUM OF ALL RECOVERED ROCK CORE PIECES FROM A CORING RUN EXPRESSED AS A PERCENT OF THE TOTAL LENGTH DRILLED IN THAT CORING RUN.

MODIFIED RECOVERY: SUM OF THOSE NATURALLY FRACTURED CORE PIECES, 4" IN LENGTH EXPRESSED AS A PERCENT OF THE LENGTH OF THE CORING RUN. THE ROCK QUALITY DESIGNATION (RQD), FOR MODIFIED RECOVERY, IS:

RQD (%)	0 - 25	25 - 50	50 - 75	75 - 90	90 - 100
	VERY POOR	POOR	FAIR	GOOD	EXCELLENT

JOINTING AND BEDDING:

SPACING	2"	2" - 12"	1' - 3'	3' - 10'	> 10'
JOINTING	VERY CLOSE	CLOSE	MOD. CLOSE	WIDE	VERY WIDE
BEDDING	VERY THIN	THIN	MEDIUM	THICK	VERY THICK

## ABBREVIATIONS & SYMBOLS

### LABORATORY TESTING

TRIAXIAL TESTS ARE DESCRIBED IN TERMS OF WHETHER THEY ARE CONSOLIDATED (C) OR NOT (U) ISOTROPICALLY (I) OR NOT (A) AND SHEARED DRAINED (D) OR UNDRAINED (U) WITH PORE PRESSURE MEASUREMENTS (BAR OVER SYMBOLS) EG.  $\bar{C}U$  = CONSOLIDATED ISOTROPIC UNDRAINED TRIAXIAL WITH PORE PRESSURE MEASUREMENT UNLESS OTHERWISE SPECIFIED IN REPORT ALL TESTS ARE IN COMPRESSION

### FIELD SAMPLING

S S SPLIT SPOON  
W S WASH SAMPLE  
S T SLOTTED TUBE SAMPLE  
B S BLOCK SAMPLE  
C S CHUNK SAMPLE  
T W THINWALL OPEN  
T P THINWALL PISTON  
O S OSTERBERG SAMPLE  
F S FOIL SAMPLE  
R C ROCK CORE  
P H T.W. ADVANCED HYDRAULICALLY  
P M T.W. ADVANCED MANUALLY

### EARTH PRESSURE TERMS

$\mu$  COEFFICIENT OF FRICTION  
 $\delta$  ANGLE OF WALL FRICTION  
 $k_o$  COEFFICIENT OF EARTH PRESSURE AT REST  
 $k_A$  COEFFICIENT OF ACTIVE EARTH PRESSURE  
 $k_P$  COEFFICIENT OF PASSIVE EARTH PRESSURE  
 $i$  ANGLE OF INCLINATION OF SURCHARGE  
 $w$  SLOPE ANGLE-BACKFACE OF WALL  
 $\beta$  ANGLE OF SLOPE  
 $N_c, N_q, N_\gamma$  BEARING CAPACITY FACTORS  
 $D_f$  DEPTH OF FOOTING  
 $B, L$  FOOTING DIMENSIONS

### INDEX PROPERTIES

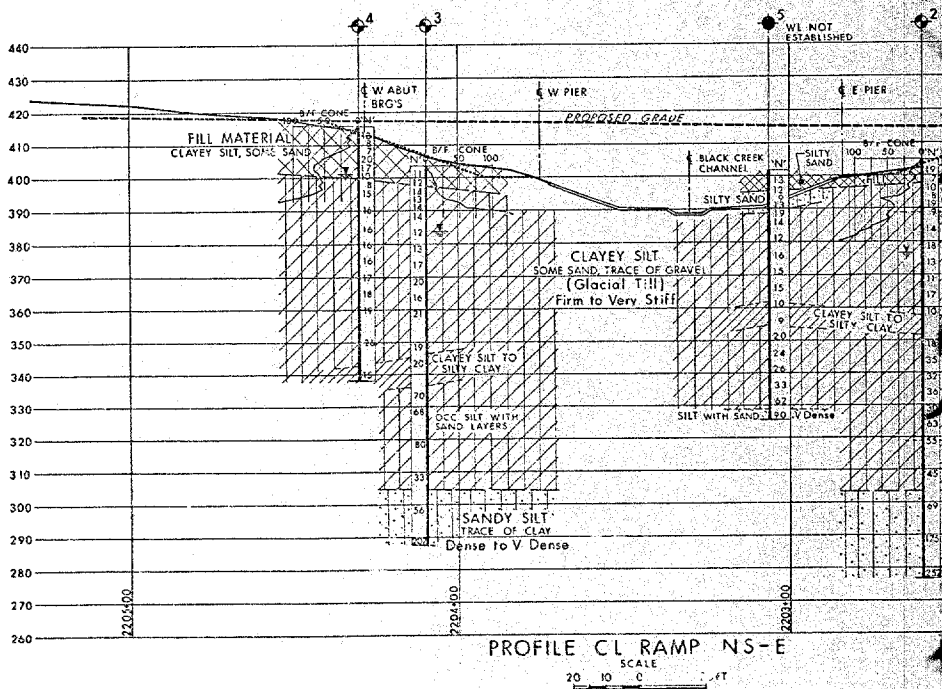
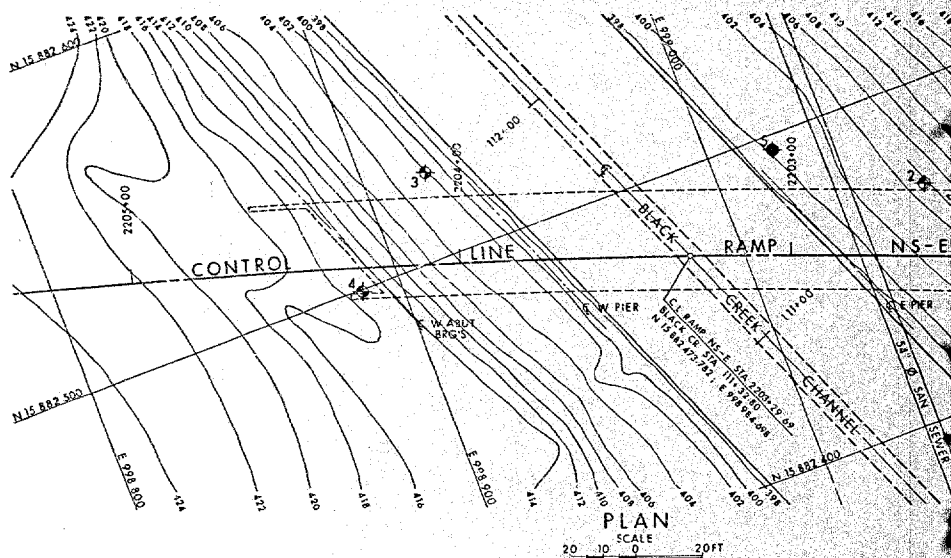
$\gamma$  UNIT WEIGHT OF SOIL (BULK DENSITY)  
 $\gamma_w$  UNIT WEIGHT OF WATER  
 $\gamma_d$  UNIT DRY WEIGHT OF SOIL (DRY DENSITY)  
 $\gamma'$  UNIT WEIGHT OF SUBMERGED SOIL  
 $G_s$  SPECIFIC GRAVITY OF SOLIDS  
 $e$  VOIDS RATIO  
 $e_o$  INITIAL VOIDS RATIO  
 $e_{max}$   $e$  IN LOOSEST STATE  
 $e_{min}$   $e$  IN DENSEST STATE  
 $D_r$  RELATIVE DENSITY =  $\frac{e_{max} - e}{e_{max} - e_{min}}$   
 $n$  POROSITY  
 $w$  WATER CONTENT  
 $w_L$  LIQUID LIMIT  
 $w_P$  PLASTIC LIMIT  
 $w_S$  SHRINKAGE LIMIT  
 $I_P$  PLASTICITY INDEX =  $w_L - w_P$   
 $I_L$  LIQUIDITY INDEX =  $\frac{w - w_P}{w_L - w_P}$   
 $I_C$  CONSISTENCY INDEX =  $\frac{w_L - w}{w_P - w}$   
 $A_c$  ACTIVITY =  $\frac{I_P}{w_L - w_P}$   
 $O_m$  ORGANIC MATTER CONTENT  
 $S_r$  DEGREE OF SATURATION  
 $S$  SENSITIVITY =  $\frac{S_o(\text{undisturbed})}{S_o(\text{remoulded})}$

### STRENGTH PARAMETERS

$\phi$  ANGLE OF SHEARING RESISTANCE  
 $\tau_f$  PEAK SHEAR STRENGTH  
 $\tau_R$  RESIDUAL SHEAR STRENGTH  
 $c$  COHESION INTERCEPT  
 $\sigma_1, \sigma_2, \sigma_3$  NORMAL PRINCIPAL STRESSES  
 $u$  PORE WATER PRESSURE  
 $u_e$  EXCESS  $u$   
 $r_u$  PORE PRESSURE RATIO  
 $q_u$  UNCONFINED COMPRESSIVE STRENGTH  
 $s_u$  UNDRAINED SHEAR STRENGTH  
 $\epsilon$  LINEAR STRAIN  
 $\gamma$  SHEAR STRAIN  
 $\nu$  POISSON'S RATIO  
 $E$  MODULUS OF ELASTICITY  
 $G$  MODULUS OF SHEAR DEFORMATION  
 $k_s$  MODULUS OF SUBGRADE REACTION  
 $m, n$  STABILITY COEFFICIENTS  
 $A, B$  PORE PRESSURE COEFFICIENTS  
  
NOTE: EFFECTIVE STRESS PARAMETERS ARE DENOTED BY USE OF APOSTROPHE ABOVE THE SYMBOL, THUS:  
 $\sigma'$  = EFFECTIVE ANGLE OF SHEARING RESISTANCE;  
 $\sigma'_v$  = EFFECTIVE VERTICAL STRESS

### HYDRAULIC TERMS

$h$  HYDRAULIC HEAD OR POTENTIAL  
 $q$  RATE OF DISCHARGE  
 $v$  VELOCITY OF FLOW  
 $i$  HYDRAULIC GRADIENT  
 $j$  SEEPAGE FORCE PER UNIT VOLUME  
 $\eta$  COEFFICIENT OF VISCOSITY  
 $k$  COEFFICIENT OF HYDRAULIC CONDUCTIVITY  
 $k_h$   $k$  IN HORIZONTAL DIRECTION  
 $k_v$   $k$  IN VERTICAL DIRECTION  
 $\alpha_v$  COEFFICIENT OF VOLUME CHANGE  
 $\alpha_v$  COEFFICIENT OF CONSOLIDATION  
 $C_c$  COMPRESSION INDEX  
 $C_r$  RECOMPRESSION INDEX  
 $d$  DRAINAGE PATH DISTANCE  
 $T_v$  TIME FACTOR  
 $U$  DEGREE OF CONSOLIDATION  
 $O_r$  OVERCONSOLIDATION RATIO (OCR)



CONT No  
WP No 33-76-11



NORTHWEST METRO ARTERIAL  
RAMP NS-E  
OVER BLACK CREEK CHANNEL  
BORE HOLE LOCATIONS & SOIL STRATA

SHEET



# LEGEND

- Bore Hole
- ⊕ Dynamic Cone Penetration Test (Cone)
- ◆ Bore Hole & Cone
- "N" Blows/ft (Std Per. Test 350ft lbs energy)
- CONE Blows/ft (60° Cone, 350ft lbs energy)
- ↓ WL at time of investigation April and May 1978
- WL Not Established in B.H.#5

No	ELEVATION	CO-ORDINATES	
		NORTH	EAST
2	404.7	15 882 469	999 058
3	403.8	15 882 526	998 919
4	415.6	15 832 499	998 888
5	401.7	15 882 495	999 019
8	403.0	15 882 424	999 068

## —NOTE—

The boundaries between soil strata have been established only at Bore Hole locations. Between Bore Holes the boundaries are assumed from geological evidence.

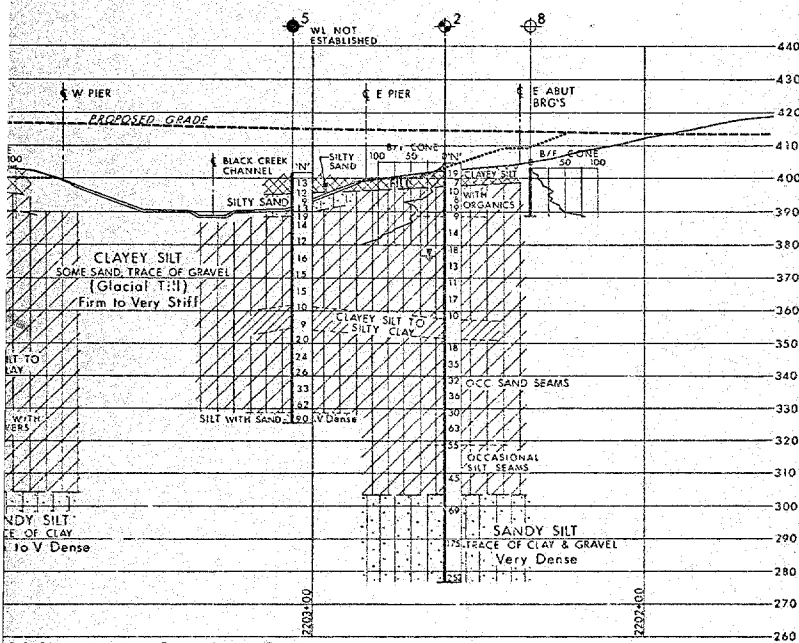
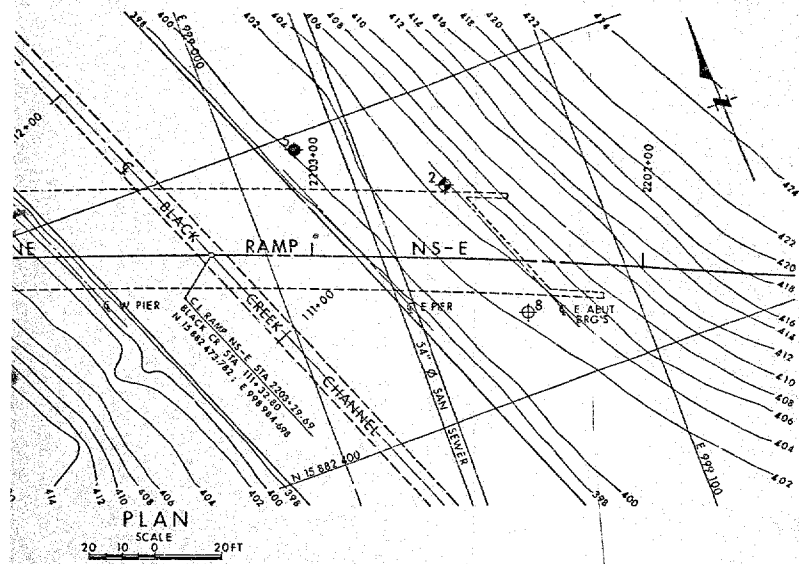
DATE	BY	DESCRIPTION

Geocres No 30M11-179

HWY No Prop. NWMA DIST. &

SUBMITT. CHECKED DATE June 8, 1978 SITE 37-1077

DRAWN BY CHECKED DATE 1978 POC 3376-11-A



\_\_\_\_\_

GEOGRES No. 35-111-170

DIST E REGION CENTRAL

W.P. No. 35-71-11

CONT. No. 71-00

W.C. No. \_\_\_\_\_

STR. SITE No. 57-111

HWY. No. NWMSA

LOCATION 800' NS-E, CBE

BLACK PESTER CHANNEL

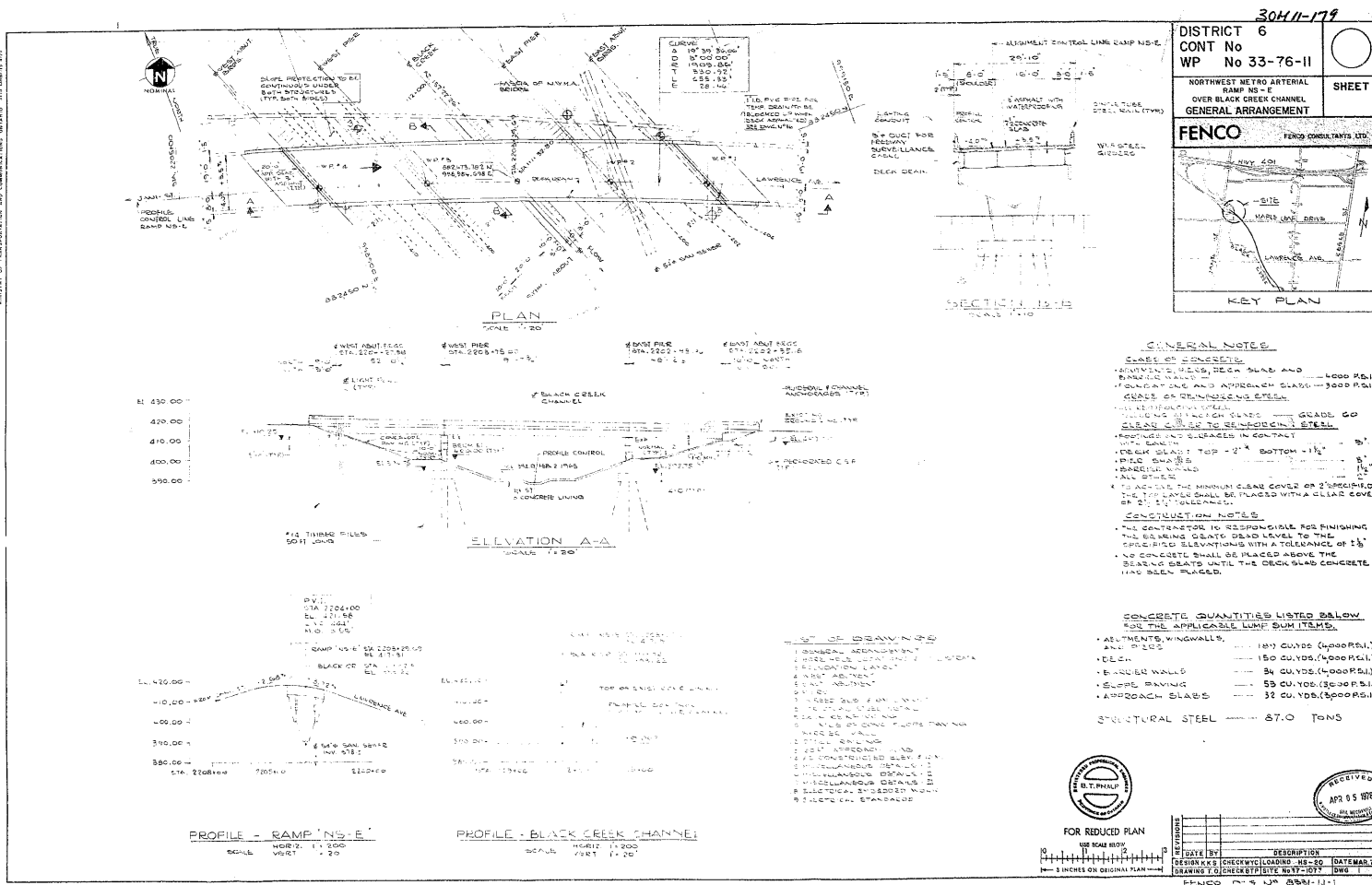
\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

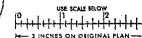
\_\_\_\_\_

\_\_\_\_\_



[illegible]

FOR REDUCED PLAN



REVIEWS	DATE BY			DESCRIPTION	DATE MAR.
	DESIGN KKS	CHECK RWH	LOADING	HS-20	
	DRAWING SHW	CHECK WYC	SITE No 37-1077	DWG 3	